

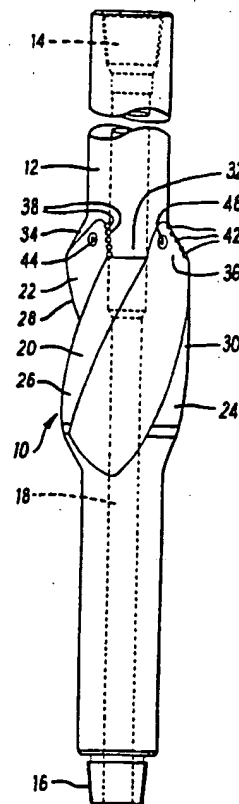


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(21) International Application Number: PCT/GB93/01203 (22) International Filing Date: 7 June 1993 (07.06.93) (30) Priority data: 9211946.0 5 June 1992 (05.06.92) GB (71) Applicant (for all designated States except US): PANTHER OIL TOOLS (UK) LIMITED [GB/GB]; Harlaw Road, Inverurie, Aberdeenshire AB51 9SR (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : SIMPSON, Neil, A., A. [GB/GB]; Burn of Daff, Downies, Aberdeen AB1 4QX (GB). (74) Agent: PACITTI, Pierpaolo, A., M., E.; Murgitroyd and Company, 373 Scotland Street, Glasgow G5 8QA (GB).		(81) Designated States: AT, AU, BB, BG, BR, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: WELL DRILLING TOOLS**(57) Abstract**

A back-reaming stabiliser (10) for incorporation in a bottom-hole assembly (BHA) on the downhole end of a drillstring. The stabiliser consists of a conventional fixed-blade stabiliser having added to it rows of PDCs (38, 40, 42) or other suitable hard inserts along the upper edges of the blades (20, 22, 24) to act as back-reaming cutters, nozzles (44, 46, 48) for directing mud at these cutters during back-reaming, and a valve (50) normally closing these nozzles. The valve is opened by remote actuation immediately prior to the start of back-reaming. The valve is preferably a sleeve (50) normally held over the nozzles by shear pins (58) which are ruptured by a flow-flocking drop member (60). The drop member preferably has a through bore (76, 78) initially blocked by a burstable diaphragm (80) such that after the sleeve (50) is opened by the drop member, mud pressure can be increased to burst the diaphragm (80) and re-open a passage for mud to the downhole end of the bottom-hole assembly. This divides mud flow between an upflow past the outside of the stabiliser, and mud jets through the nozzles to the back-reaming cutters. The invention avoids the wastage of mud that would occur if the back-reaming cutter nozzles were permanently open.



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1 "Well Drilling Tools"

2

3 This invention relates to well-drilling tools, and
4 relates more particularly but not exclusively to a
5 well-drilling tool in the form of a back-reaming
6 stabiliser incorporating back-reaming cutter means and
7 valve means controllably operable to divert
8 well-drilling fluid to said cutter means.

9

10 The back-reaming stabiliser is particularly but not
11 exclusively applicable to the drilling of wells where
12 the drilled formation may swell or slough into the
13 wellbore and thereby restrict egress of the
14 drillstring. In this context, it is known that the
15 drilling of wells, particularly oil wells, through
16 geological formations which are under extreme local
17 pressures has inherent problems due to the wellbore
18 becoming restricted by these rocks swelling or
19 sloughing into it. In certain instances the formation
20 will exhibit a plastic flow and may restrict the
21 wellbore diameter over many metres.

22

23 To counteract this problem it has been common practice
24 to use the uppermost drillstring stabiliser (furthest

1 from bit) in the BHA (bottom hole assembly) as a
2 back-reaming stabiliser if a restriction is encountered
3 during withdrawal of the drillstring from the wellbore.
4 In such an instance the drillstring is withdrawn slowly
5 from the wellbore whilst rotating at normal drilling
6 speeds, such that the stabiliser blades cut or ream a
7 passage back through the restricted zone. However,
8 this has the disadvantage that the use of a drillstring
9 stabilising element not specifically designed for a
10 cutting operation is:-

11

12 (a) a slow and laborious, and therefore expensive
13 operation; and

14

15 (b) the stabiliser is usually seriously damaged as a
16 consequence.

17

18 A stabiliser which is specifically designed to have an
19 additional back-reaming function by the provision of
20 suitably located cutters will usually require that the
21 cutters be supplied with mud or other appropriate
22 well-drilling fluid for the purposes of cooling,
23 lubrication, and debris removal. The mud will be
24 supplied to the cutters by way of nozzles in the
25 stabiliser. The same mud or other well-drilling fluid
26 will be similarly supplied to the drillbit normally
27 present at the downhole (bottom) end of the BHA.
28 However, the drillbit and the back-reaming cutters will
29 be required to work at mutually different times,
30 according to whether the intended direction of progress
31 of the drillstring is downhole or uphole. Accordingly,
32 the simultaneous supply of mud to the drillbit and to
33 the back-reaming cutters represents an inefficient use
34 of the mud supply, the inefficiency manifesting itself,
35 for example, as an unnecessarily high power consumption

1 by the mud pump. Nevertheless, the back-reaming
2 cutters must be reliably supplied with mud or other
3 appropriate well-drilling fluid during back-reaming
4 operation.

5
6 It is therefore an object of the invention to provide
7 an improved back-reaming stabiliser.

8
9 According to the present invention there is provided a
10 back-reaming stabiliser comprising a tubular body from
11 which a plurality of stabiliser blades extend, said
12 tubular body having a through passage for hydraulic
13 fluid to flow internally through said tubular body
14 between opposite ends of said stabiliser in use
15 thereof, said stabiliser blades extending radially
16 outwards of said tubular body, said stabiliser blades
17 extending longitudinally at least partially along said
18 tubular body, said stabiliser blades extending
19 circumferentially at least partially around said
20 tubular body, radially outer edges of said stabiliser
21 blades being formed as wellbore-bearing surfaces to
22 provide a radially supportive function in use of said
23 stabiliser, longitudinally common end edges of said
24 stabiliser blades being formed as back-reaming cutter
25 means, and fluid vent means coupling said through
26 passage to the exterior of said stabiliser for the flow
27 therethrough of hydraulic fluid from said through
28 passage to said cutter means, said back-reaming
29 stabiliser being characterised by further comprising
30 valve means normally closing said fluid vent means to
31 the flow of hydraulic fluid therethrough, said valve
32 means being selectively operable during downhole use of
33 said stabiliser to open said fluid vent means to the
34 flow of hydraulic fluid therethrough.

35

1 Said valve means may comprise a sleeve means movable in
2 said through passage between a first position of said
3 sleeve means in which said sleeve means closes said
4 fluid vent to the passage of hydraulic fluid
5 therethrough, and a second position of said sleeve
6 means in which said sleeve means opens said fluid vent
7 means to the passage of hydraulic fluid therethrough,
8 said sleeve means being movable from said first
9 position thereof to said second position thereof by the
10 application of a substantial pressure differential
11 between longitudinally opposite ends thereof. Said
12 sleeve means is preferably normally retained in said
13 first position thereof by shear means rupturable by
14 said application of said substantial pressure
15 differential between longitudinally opposite ends of
16 said sleeve means thereupon to release said sleeve
17 means from said first position thereof for movement to
18 said second position thereof. Movement of said sleeve
19 means from said first position thereof to said second
20 position thereof may be by way of sliding movement
21 longitudinally along said through passage. Said sleeve
22 means may be formed with an internal passage extending
23 longitudinally therethrough and locally defining said
24 through passage of said stabiliser, said substantial
25 pressure differential being created by causing an at
26 least temporary blockage of flow of hydraulic fluid
27 through said internal passage extending longitudinally
28 through said sleeve means. Such hydraulic flow
29 blockage may be caused by manoeuvring a
30 flow-blockage-inducing means into said internal passage
31 through said sleeve means. Said flow-blockage-inducing
32 means may comprise a drop means introduced to said
33 stabiliser by being dropped into the bore of the
34 drillstring of which the stabiliser forms part. Said
35 drop means preferably comprises a generally tubular

1 member having a longitudinal through bore initially
2 blocked to the passage of hydraulic fluid therethrough
3 by a rupturable diaphragm extending thereacross, said
4 tubular member being formed to lodge in said sleeve
5 means, preferably by forming said tubular member with
6 an external shoulder dimensioned to engage positively
7 with said sleeve means which may be formed with an
8 internal shoulder for that purpose.

9
10 Said longitudinally common end edges of said stabiliser
11 may be formed as said back-reaming cutter means by
12 embedding a plurality of hard inserts in leading
13 portions of said edges, preferably so as to lie
14 substantially in a common notional surface of
15 revolution, which surface may be conical. Each said
16 hard insert may be a PDC (polycrystalline diamond
17 compact), or a chip of tungsten carbide. Said fluid
18 vent means may comprise a respective fluid nozzle
19 adjacent each said cutter-formed end edge of said
20 stabiliser blades.

21
22 Embodiments of the invention will now be described by
23 way of example with reference to the accompanying
24 drawings wherein:-

25
26 Fig 1 is an elevation of an embodiment of
27 back-reaming stabiliser in accordance with the
28 invention;

29
30 Fig 2 is a plan view of the stabiliser of Fig 1;

31
32 Fig 3 is a longitudinal section of the stabiliser
33 of Fig 1, taken on the line III-III in Fig 2;

34
35 Fig 4 is a transverse section of the stabiliser of

1 Fig 1, taken on the line IV-IV in Fig 3; and

2

3 Fig 5 is a longitudinal section, to a
4 much-enlarged scale, of a drop member for use with
5 the stabiliser of Fig 1.

6

7 Referring first to Figs 1-4 (which are different views
8 of the same article, to a common scale), a back-reaming
9 stabiliser 10 in accordance with the present invention
10 is basically formed as a conventional fixed-blade
11 stabiliser, though with certain modifications and
12 additions (detailed subsequently) to meet the object of
13 the invention.

14

15 The stabiliser 10 comprises an elongate tubular body 12
16 having a standard API (American Petroleum Institute)
17 box connector 14 at its upper end, and a standard API
18 pin connector 16 at its lower end. The connectors 14
19 and 16 enable the stabiliser 10 to be coupled into a
20 BHA (bottom hole assembly; not shown), the BHA being
21 connected to the downhole end of a drillstring (not
22 shown).

23

24 The tubular body 12 has a through passage 18 for
25 carrying a flow of mud (well-drilling fluid) or other
26 hydraulic fluid between the connectors 14 and 16 in use
27 of the stabiliser 10.

28

29 In a known manner, the body 12 is integrally formed
30 with three stabiliser blades 20, 22 and 24 each
31 extending radially outwards of the body 12 along a
32 central part of its length. The blades 20-24 are
33 equi-angularly located around the body 12 (see Figs 2
34 and 4), and are spirally shaped (see Fig 1) such that,
35 as a whole, the blades 20-24 extend circumferentially

1 around the body 12 to define the outer periphery of the
2 stabiliser 10 (see Fig. 2). The respective radially
3 outer edges 26, 28 and 30 of the stabiliser blades 20,
4 22 and 24 are formed as wellbore-bearing surfaces such
5 that the stabiliser 10 provides the conventional
6 radially supportive function in operation as part of a
7 BHA.

8
9 The respective upper ends 32, 34 and 36 of the
10 stabiliser blades 20, 22 and 24 are formed as
11 back-reaming cutters by being each inset with a
12 respective row of PDCs 38, 40 and 42 which collectively
13 sit on a notional cone coaxial with the stabiliser 10
14 and converging upwardly. The body 12 is fitted with
15 three radially directed nozzles 44, 46 and 48 between
16 each of the cutter sets 38-42 (see Figs 2, 3 and 4).
17 The nozzles 44-48 are each fed from the central through
18 passage 18 during back-reaming, but during normal
19 downwardly directed drilling, the nozzles 44-48 are
20 closed off by a sleeve 50 (Figs 3 and 4) which is a
21 sliding fit in the bore of the through passage 18. The
22 sleeve 50 is held in a position in which it normally
23 blocks fluid flow to the nozzles 44-48 by being secured
24 to the lower end of a tubular mounting 52 having an
25 external shoulder 54 which sits on a matching shoulder
26 56 in the bore of the through passage 18. The sleeve
27 50 is secured to the mounting 52 by means of shear pins
28 58 (Fig 3; only one pin being visible).

29
30 When the stabiliser 10 is required to operate as a
31 back-reamer, it is necessary to initiate flow of
32 well-drilling fluid outwards through the nozzles 44, 46
33 and 48 for the reasons previously discussed.
34 Consequently, it is necessary to slide the sleeve 50
35 down the bore of the through passage to a position in

1 which the sleeve 50 no longer blocks fluid outflow
2 through the nozzle 44-48. Since the stabiliser 10 will
3 at that time be part of a BHA deep down a well, remote
4 operation of the sleeve 50 is clearly necessary (ie
5 direct manual movement of the sleeve 50 in such
6 circumstances is utterly impossible). A drop member 60
7 for achieving such remote movement of the sleeve 50
8 will now be detailed with reference to Fig 5 (wherein
9 the drop member 60 is depicted to a much larger scale
10 than the stabiliser 10 is shown in Figs 1-4).

11
12 Referring to Fig 5, the drop member 60 is generally
13 tubular in shape and has an external diameter
14 sufficiently small as to allow the member 60 to drop
15 down the bore of the drillstring, and to enter the bore
16 of the sleeve mounting 52 (Fig 3). The upper end of
17 the drop member 60 is formed with a small external
18 shoulder 62 dimensioned to seat on an internal shoulder
19 64 at the lower end of the sleeve 50 (Fig 3). The
20 external diameter of the drop member 60 below the
21 shoulder 62 is marginally less than the internal
22 diameter of the sleeve shoulder 64 so as to allow the
23 drop member 60 to pass down through the sleeve 50 until
24 the shoulder 62 seats on the sleeve shoulder 64,
25 whereupon all further downward movement of the drop
26 member 60 is halted.

27
28 The drop member 60 is formed of an upper component 66
29 and a lower component 68 which are normally mutually
30 secured by means of a screw thread 70, a tight threaded
31 connection of the components 66 and 68 conveniently
32 being achieved by the application of spanners (not
33 shown) to external flats 72 and 74. The components 66
34 and 68 have respective longitudinal through bores 76
35 and 78 which are initially sealed off one from the

1 other by means of a burstable diaphragm 80 clamped
2 between the components 66 and 68 to extend fully across
3 the bores 76 and 78.

4
5 Operation of the invention will now be described. As
6 described above with reference to Figs 1-4, the
7 stabiliser 10 provides the conventional radially
8 supportive function of the conventional fixed-blade
9 stabiliser which it resembles, and which need not be
10 further detailed. When required to function as a
11 back-reamer, normal rotation of the stabiliser 10 is
12 continued (clockwise as viewed from above, ie clockwise
13 as viewed in Figs 2 and 4), but a suitable upforce is
14 applied to the drillstring and through it, the upforce
15 is applied to the BHA of which the stabiliser 10 is a
16 part. This causes the cutter sets 42, 44 and 46 to
17 bite into the wellbore intrusion. As already detailed,
18 the nozzles 44, 46 and 48 have to be opened prior to
19 commencement of back-reaming. Between the termination
20 of down-drilling and the commencement of back-reaming,
21 the drop member 60 is released into the bore of the
22 drillstring to drop down or be forced by pumped mud to
23 the stabiliser 10 wherein it passes down the through
24 bores of the sleeve mounting 52 and of the sleeve 50,
25 until the external drop member shoulder 62 lodges on
26 the internal sleeve shoulder 64 to halt the downward
27 movement of the drop member 60. In this position, the
28 drop member 60, together with the diaphragm 80,
29 restrict or block the flow of mud down the drillstring.
30 When the mud-induced downforce on the drop member 60
31 becomes sufficiently high (with increased mud pumping,
32 if necessary), the shear pins 58 will rupture and
33 thereby allow the sleeve 50 to be moved downwards from
34 its initial nozzle-blocking position as shown in Fig 3,
35 to a lower position in which the nozzles 44, 46, and 48

1 are opened for outflow of mud therethrough as
2 previously detailed. Next, the pressure of the mud on
3 the diaphragm 80 is increased (notwithstanding the
4 now-commenced mud outflow through the nozzles 44-46),
5 eg by increasing the working speed of the mud pumps
6 (not shown), to a level at which the diaphragm 80
7 bursts, thereby re-establishing mud flow down through
8 the stabiliser 10 to the drillbit.
9

10 The collective rupturing force of the shear pins 58 at
11 any given mud pressure will be selected to be less than
12 the equivalent rupturing force of the diaphragm 80 at
13 the same mud pressure, ie it will be arranged that the
14 shear pins 58 will always rupture before the diaphragm
15 80 ruptures to ensure the intended sequence of
16 operations.
17

18 Mud flow down the drillstring is now split between the
19 stabiliser nozzles 44-48 and the drillbit nozzles (not
20 shown) in proportion to their relative flow areas, with
21 the greater portion of mudflow preferably going through
22 the drillbit to establish a substantial upflow of mud
23 past the exterior of the stabiliser 10 for removal of
24 debris arising from back-reaming operation of the
25 cutters 38-42. The lesser portion of mudflow goes
26 through the nozzles 44-48 to provide the cooling,
27 lubrication, and cleaning functions previously
28 detailed.
29

30 As the back-reaming operation takes place the
31 drillstring will be rotated at normal drilling speeds
32 as it is slowly withdrawn from the wellbore. The
33 cutters mounted on each stabiliser blade will cut and
34 remove the formation and hence permit the egress of the
35 BHA past the restriction.

1 The above example is cited as a simple, effective but
2 non-repeating means of back-reaming through a wellbore
3 restriction. By adaption of the mechanism used to
4 divert the mud flow through the stabiliser nozzles, it
5 would be possible to have a back-reaming stabiliser
6 capable of back-reaming through a number of
7 restrictions in the wellbore. This repeatability could
8 be engendered by the use of sleeves or special valves
9 in the stabiliser body; valves which may be activated
10 by either hydraulic or mechanical means which would
11 return to a detente position when the means of
12 activation was removed.

13
14 Whichever flow diverting valve means is used it is
15 preferred that the through bore of the stabiliser is
16 such that fishing and survey equipment may pass through
17 it without impinging on the valve operating mechanism
18 or snagging on any shoulders or ledges.

19
20 While certain modifications and variations have been
21 described above, the invention is not restricted
22 thereto, and other modifications and variations can be
23 adopted without departing from the scope of the
24 invention as defined in the appended claims.

25

1 Claims

- 2
- 3 1. A back-reaming stabiliser comprising a tubular
4 body from which a plurality of stabiliser blades
5 extend, said tubular body having a through passage
6 for hydraulic fluid to flow internally through
7 said tubular body between opposite ends of said
8 stabiliser in use thereof, said stabiliser blades
9 extending radially outwards of said tubular body,
10 said stabiliser blades extending longitudinally at
11 least partially along said tubular body, said
12 stabiliser blades extending circumferentially at
13 least partially around said tubular body, radially
14 outer edges of said stabiliser blades being formed
15 as wellbore-bearing surfaces to provide a radially
16 supportive function in use of said stabiliser,
17 longitudinally common end edges of said stabiliser
18 blades being formed as back-reaming cutter means,
19 and fluid vent means coupling said through passage
20 to the exterior of said stabiliser for the flow
21 therethrough of hydraulic fluid from said through
22 passage to said cutter means, said back-reaming
23 stabiliser being characterised by further
24 comprising valve means normally closing said fluid
25 vent means to the flow of hydraulic fluid
26 therethrough, said valve means being selectively
27 operable during downhole use of said stabiliser to
28 open said fluid vent means to the flow of
29 hydraulic fluid therethrough.
30
- 31 2. A back-reaming stabiliser as claimed in Claim 1,
32 wherein said valve means comprises a sleeve means
33 movable in said through passage between a first
34 position of said sleeve means in which said sleeve
35 means closes said fluid vent to the passage of

- 1 hydraulic fluid therethrough, and a second
2 position of said sleeve means in which said sleeve
3 means opens said fluid vent means to the passage
4 of hydraulic fluid therethrough, said sleeve means
5 being movable from said first position thereof to
6 said second position thereof by the application of
7 a substantial pressure differential between
8 longitudinally opposite ends thereof.
9
- 10 3. A back-reaming stabiliser as claimed in Claim 2,
11 wherein said sleeve means is normally retained in
12 said first position thereof by shear means
13 rupturable by said application of said substantial
14 pressure differential between longitudinally
15 opposite ends of said sleeve means thereupon to
16 release said sleeve means from said first position
17 thereof for movement to said second position
18 thereof.
19
- 20 4. A back-reaming stabiliser as claimed in Claim 2 or
21 Claim 3, wherein movement of said sleeve means
22 from said first position thereof to said second
23 position thereof is by way of sliding movement
24 longitudinally along said through passage.
25
- 26 5. A back-reaming stabiliser as claimed in Claim 2 or
27 Claim 3 or Claim 4, wherein said sleeve means is
28 formed with an internal passage extending
29 longitudinally therethrough and locally defining
30 said through passage of said stabiliser, said
31 substantial pressure differential being created by
32 causing an at least temporary blockage of flow of
33 hydraulic fluid through said internal passage
34 extending longitudinally through said sleeve
35 means.

- 1 6. A back-reaming stabiliser as claimed in Claim 5,
2 wherein said hydraulic flow blockage is caused by
3 manoeuvring a flow-blockage-inducing means into
4 said internal passage through said sleeve means
5 and said flow-blockage-inducing means comprises a
6 drop means introduced to said stabiliser by being
7 dropped into the bore of the drillstring of which
8 the stabiliser forms part.
9
- 10 7. A back-reaming stabiliser as claimed in Claim 6
11 wherein said drop means comprises a generally
12 tubular member having a longitudinal through bore
13 initially blocked to the passage of hydraulic
14 fluid therethrough by a rupturable diaphragm
15 extending thereacross, said tubular member being
16 formed to lodge in said sleeve means.
17
- 18 8. A back-reaming stabiliser as claimed in Claim 7
19 wherein said tubular member is formed with an
20 external shoulder dimensioned to engage positively
21 with said sleeve means.
22
- 23 9. A back-reaming stabiliser as claimed in any
24 preceding claim wherein said longitudinally common
25 end edges of said stabiliser are formed as said
26 back-reaming cutter means by embedding a plurality
27 of hard inserts in leading portions of said edges.
28
- 29 10. A back-reaming stabiliser as claimed in Claim 9
30 wherein said inserts are located so as to lie
31 substantially in a common notional surface of
32 revolution.
33
- 34 11. A back-reaming stabiliser as claimed in Claim 10
35 wherein said notional surface of revolution is

1 conical, and convergent in the longitudinal
2 direction of back-reaming operation.

3

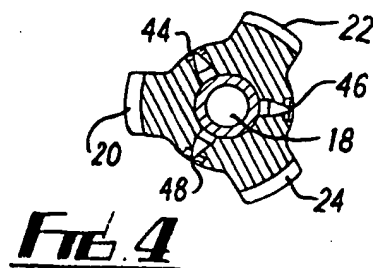
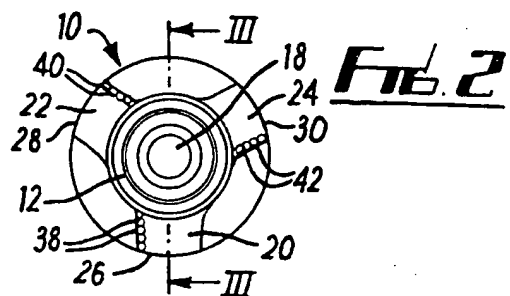
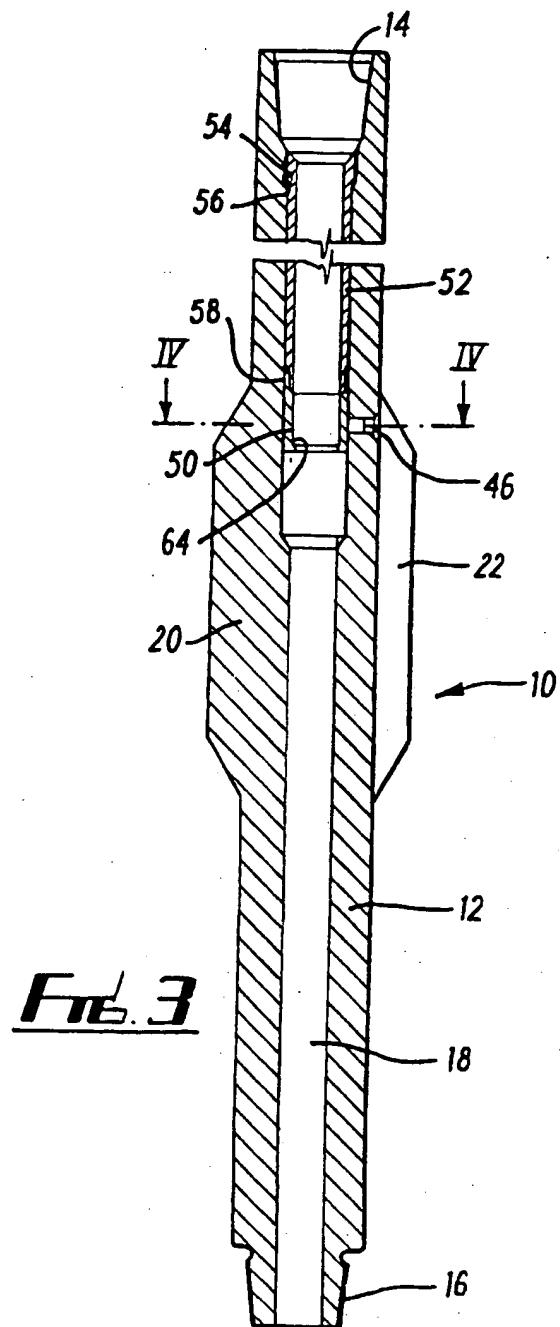
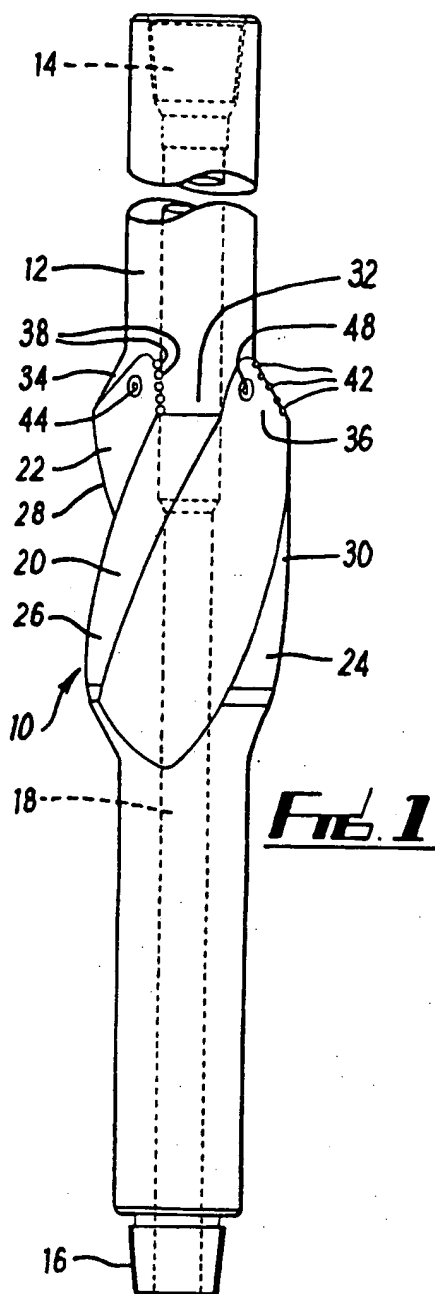
4 12. A back-reaming stabiliser as claimed in any
5 preceding claim wherein said fluid vent means
6 comprises a respective fluid nozzle adjacent each
7 said cutter-formed end edge of said stabiliser
8 blades.

9

10 13. A back-reaming stabiliser as claimed in any
11 preceding claim wherein said valve means is
12 adapted for controllable cyclic operation
13 repeatedly to open and close said fluid vent means
14 to the flow of hydraulic fluid therethrough at
15 selected times whereby said stabiliser may
16 undertake plural episodes of back-reaming
17 operation between which episodes said valve means
18 re-closes said fluid vent means to the flow of
19 hydraulic fluid therethrough.

20

21 14. A back-reaming stabiliser as claimed in claim 13
22 wherein said valve means is adapted to open upon
23 the application thereto of a valve-opening force,
24 and to close automatically upon cessation of said
25 valve-opening force.



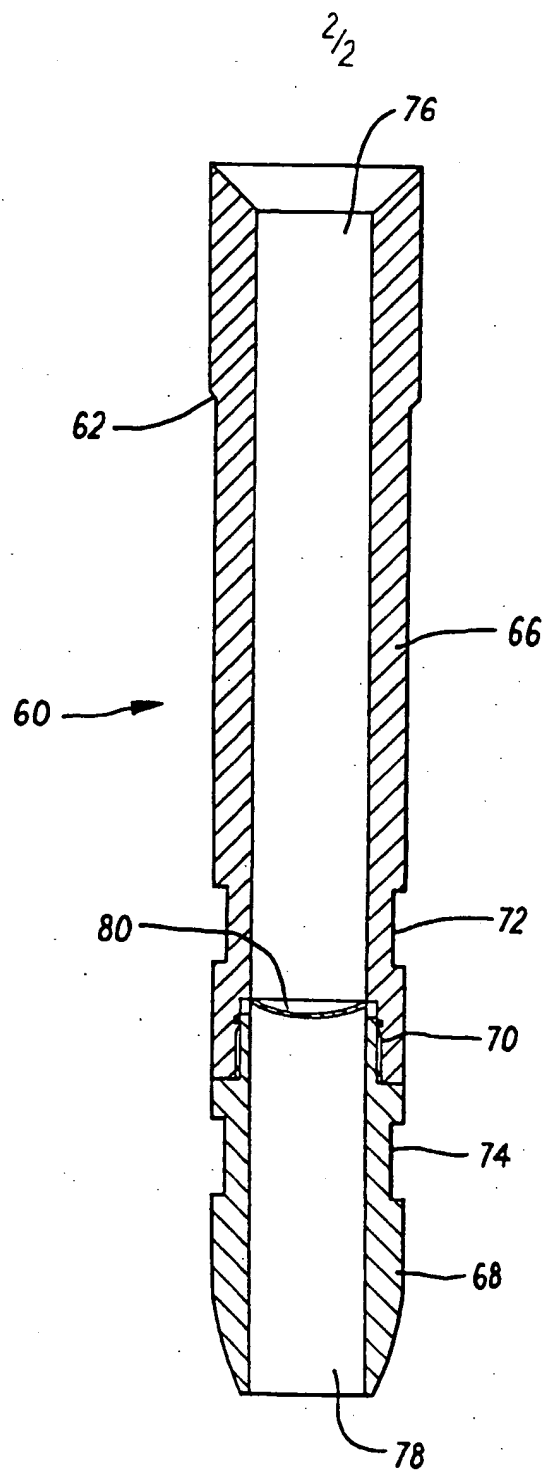


Fig. 5

INTERNATIONAL SEARCH REPORT

PCT/GB 93/01203

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5	E21B10/26; E21B21/10;	E21B10/60; E21B17/10
E21B34/10; E21B34/14		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	E21B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	US,A,4 583 603 (DORLEANS) 22 April 1986 see the whole document ---	1,9,10, 11,12
A	US,A,4 618 010 (FALGOUT) 21 October 1986 see the whole document ---	1,9-12
A	US,A,3 237 705 (WILLIAMS) 1 March 1966 see figures 2-4 ---	1
A	US,A,3 981 360 (MARATHE) 21 September 1976 see abstract; figures 2,3 ---	1-4
-/--		
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IV. CERTIFICATION		
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19 OCTOBER 1993	11. 11. 93	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	Héctor Fonseca	

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